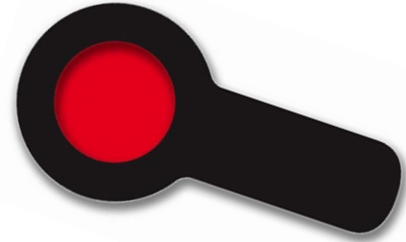
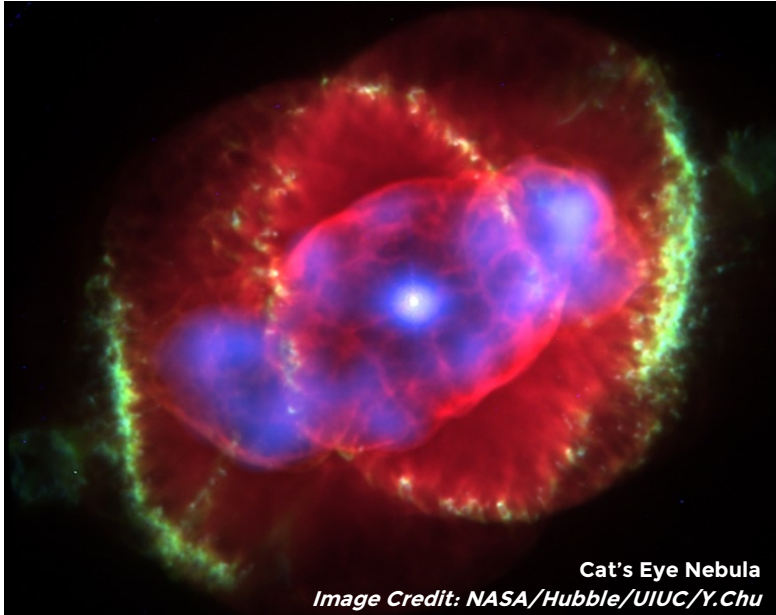


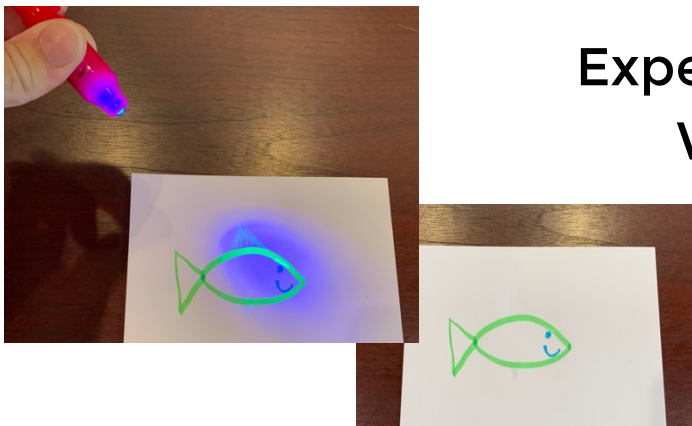
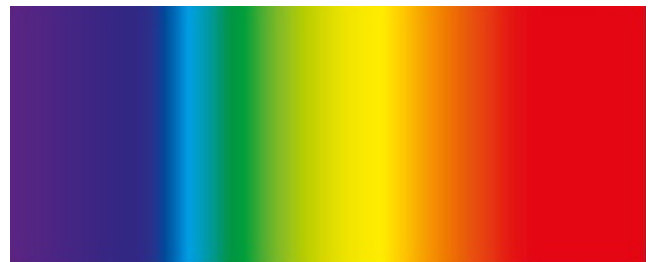
# Clues to the Cosmos

Discover the secrets of light and filters



Explore the  
images using  
different  
color filters.

What do you notice?  
What do the filters do?

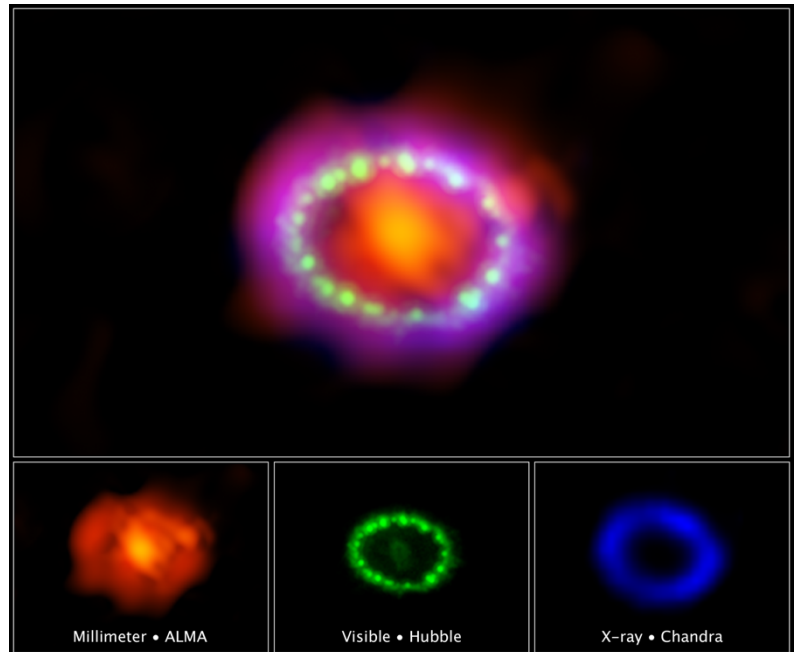


Experiment with the markers!  
Write a secret message or  
draw a picture that  
appears under UV light.

# Astronomers use filters to help them focus on one type of light at a time.

Look at some of your favorite images with the filters. What can you discover by looking at different types of images?

- What do you notice about what you see through each filter?
- What is the filter doing?
- What color does each filter let through?



Astronomers use *representational color* to show light we can't see with our eyes.

Above, X-rays are shown in blue.

## Supernova 1987A

Radio: ESO/NAOJ/NRAO/ALMA; Optical: NASA/STScI;  
X-ray: NASA/CXC/SAO/PSU/K.Frank et al.



Astronomers at the Gemini telescope in Chile use many spectrometers to view multiple objects at a time.

Credit: NOIRLab

Each filter gives clues about the temperature of a distant object, about its movement, and even its composition.

Some telescopes use instruments called *spectrometers* to gather information about the cosmos. They break the light up to see details that are otherwise hidden.

# Notes for the Presenter

## Clues to the Cosmos

**Time:** 5-20 minutes

**Visitors:** General audience, ages 5+ with extensions for younger learners

**Venue:** daytime, table and writing surface needed

### Learning Goals

1. Understand that there are more colors of light than our eyes can see and that different telescopes detect different types of light.
2. Understand that filters block all but one color or type of light and that artists, astronomers, and decoders use filters to help to focus on just one type of light at a time.
3. Understand that white light is made of many colors of light and that different types of light give us different information.

### Materials (and Sources)

- 5 Clues to the Cosmos postcards (Print here: [bit.ly/cluescosmos](http://bit.ly/cluescosmos))
- 6 highlighters - 2 each of blue, green, and pink (Sharpie brand blue and pink work well, most greens work)
- 2 UV reactive pens with UV lights on the tops (search “spy pens”)
- 6 filters - 2 each of blue, green, and red ([Rainbow Symphony](#))
- Consumables (you provide) - scrap blank white paper for drawing
- (Optional) add another dimension to the drawing with black paper and red and blue crayons

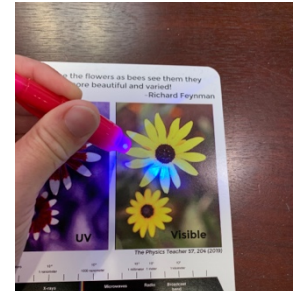
### Advance preparation

Before you begin:

- Use the UV reactive pen to on the yellow flower picture as shown. The UV light will make the ink fluoresce so you can see what you are drawing.

Setup:

- Place all of the images on the table picture-side up.
- Have an area for drawing with highlighters separate from the images.
- Keep a set of filters in each area.



### Facilitation Notes

In this open-ended exploration, use the interests of your visitors to lead the discussion. There are often many misconceptions relate to how filters work. Encourage participants to discover on their own, using prompts such as, “That’s interesting. What do you think would happen if...” and, “Tell me more about that.” Often, they will come to the right answer on their own and the understanding of discovery is much more powerful than being told facts.

## Background Information

In this activity we touch on the idea of **representational color**, showing how astronomers use visible colors to represent light that we cannot see with our eyes. While scientists often refer to “false color images,” in public outreach this term can cause misconceptions, so we try to avoid it. Representational colors help scientists pay attention to specific features like dust, energetic particles, or temperature and provides a more complete picture, even if it is not how the object appears to human eyes.

The idea that bees and other animals see in Ultraviolet (UV) light can be confusing. The ink in the included pens reacts when exposed to UV light, fluorescing the otherwise invisible ink. This approximates what a bee might see. Here again we are using representational color to create a more complete picture of the flowers, showing patterns not visible to our eyes.

## Virtual Presentation Extensions

- Create your own multiwavelength images: [public.nrao.edu/color/](http://public.nrao.edu/color/)
- NSN's Universe in a Different Light activity gives examples of many places we use representational color, from cell reception to distant galaxies: [bit.ly/different-light-nsn](http://bit.ly/different-light-nsn)
- Recoloring the Universe coding project for middle school: [chandra.harvard.edu/edu/pencilcode/pencil\\_paper.html](http://chandra.harvard.edu/edu/pencilcode/pencil_paper.html)
- See the ALMA live webcam: [public.nrao.edu/alma-webcam/](http://public.nrao.edu/alma-webcam/)
- For very young visitors, simply observe colors – Play an “eye-spy” game on each other’s screens. Virtual backgrounds add additional fun.

## Additional Resources and Credits

This activity was adapted from the NISE Network activity [Exploring the Universe: Filtered Light](#). There are many useful resources on that page to supplement this activity, including [more images](#) for use with the filters.



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